Owner's Manual

DE19K2/9K6 Modem

(G3RUH compatible 19,200/9,600 baud)

[redacted]

Kantronics
RF Data Communications Specialists

Owner's Manual

DE19K2/9K6 Modem

(G3RUH compatible 19,200/9,600 baud)

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We have attempted to make this manual technically and typographically correct as of the date of the current printing. Production changes to the DE19K2/9K6 may add errata or addendum sheets. We solicit your comments and/or suggested corrections. Please send to Kantronics Co., Inc., 1202 E. 23rd Street, Lawrence, KS 66046.

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Limited Warranty

Kantronics Company, Inc. warrants to the first consumer purchaser, for a period of one year from the date of purchase, that this product will be free from defects in material and workmanship, and agrees that it will, at its option, repair or replace the defective parts or the product at no charge for parts or labor.

This warranty does not apply to the cosmetic appearance of the product, or to any product that has been subject to misuse, abuse, overvoltage, or other cause beyond our reasonable control.

This warranty does not apply to any unit that has been modified by the consumer unless specifically authorized by Kantronics Company, Inc, in writing.

In no event shall Kantronics be held liable for damages due to fire, flood, civil disobedience, riot, acts of God or damages incurred in shipping due to poor packaging. Kantronics shall not be held liable in the event the defect is found to be caused by improper parameter settings which are cleared by performing a hard reset.

Kantronics shall not be liable for any incidental or consequential damages arising from the use of the product or due to the non-availability for use of the product under any circumstances.

Some States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

In order to enforce the rights under this limited warranty, the purchaser should mail, ship or carry the product, together with proof of purchase, to Kantronics Company, Inc, 1202 East 23rd Street, Lawrence, Kansas 66046. The consumer must also provide adequate proof of purchase indicating the date the product was purchased.

There are no other warranties, including the implied warranty of fitness for a particular purpose, not specified herein with regards to this product. Neither the sales personnel of the seller nor any other person is authorized to make any warranties other than those described herein, or to extend the duration of any warranties beyond the time period described above.

This warranty is not assignable by the original consumer. Any attempt to assign or transfer any of the rights, duties or obligations hereof is void.

Any product returned for warranty service and our inspection and testing shall determine no defect exists which is covered by this warranty, shall be charged a minimum of one-half hour labor plus return shipping charges.

This warranty gives you specific legal rights and you may also have other rights which vary from State to State.

Return/Repair Procedures

Consult the limited warranty policy in this manual for the service provisions offered by Kantronics at no charge. This warranty is considered to be in force only when the customer has submitted a completed warranty registration within 10 days of purchase, and when the stipulations of the warranty have been met. Violations of warranty clauses will automatically void the warranty and service or repairs will be charged to the owner.

Service outside the warranty will be charged at the cost of parts, labor, and return shipping. Units returned for service without a Return Authorization number will be subject to a minimum charge of 1/2 hour labor plus shipping and handling. Contact the Service Department (913-842-4476) to obtain a Return Authorization number. Repaired units will be returned via UPS C.O.D. These C.O.D. charges can be avoided by including your VISA or MasterCard number with your unit to be repaired. Shipping and repair may then be charged.

When service or repairs appear necessary, it may be wise to call or write Kantronics to determine if the problem can be solved without returning the unit. Should you encounter difficulty in getting your Modem to operate, carefully check to be sure the Modem is properly seated, before calling or writing.

When calling, report the product name and ask for the Amateur Radio Service Department. Should you find it necessary to call for assistance, please have available the unit name and serial number (the serial number is found on the Modem header.)

The Service Department telephone hours are 9 am - noon and 2 pm - 5 pm Central Time 913-842-4476, Monday through Friday.

When writing, include a clear description of the problem, unit name, computer type, computer software used and if possible a DISPLAY listing from the TNC.

Returns to the factory for refund or exchange are strictly regulated. Any return for refund or exchange must be approved by the service department.

Radio Frequency Interference Statement

NOTE: This equipment has been verified to comply with the limits for a Class B digital Device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced Radio/TV technician for help.

The user is cautioned that any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

RFI Suppression

In moving to the world of digital communications via computers, a new dimension of RFI may be encountered. In spite of the equipment manufacturers' diligence, each new piece of electronic equipment will react differently in each separate environment. Every amateur station will have its own unique layout, equipment variation, and antenna installations. Experience has shown that these differences are related to the total RF environment, and may be causative factors in RFI induced problems. The suggestions given here may assist in resolving RFI problems you may encounter in your "unique" station.

1. Use shielded cable for all connections between equipment.
2. Make all interconnecting cables as short as practical. A balance should be maintained between cable length and equipment proximity. At times simply moving the video monitor one foot further from an interface or other device will solve the "screen hash" problem.
3. Antenna runs should be kept away from equipment control lines and/or interconnecting cables. If it is necessary for such lines to cross each other they should do so at 90 degree angles.
4. Ground leads should be as short as possible and go to a GOOD EARTH GROUND.
5. Interconnecting cables appearing to act as radiators or antennas should be looped through a toroid. Be certain toroids, if used, are designed for the frequency in use.

General

The DE19K2/9K6 modem is a Direct Frequency Shift Key (DFSK) modem capable of operating at either 9600 or 19,200 baud. The pc board is designed to plug into either port of a Kantronics Data Engine, and it is compatible with the G3RUH DFSK format at 9600 baud. The DE19K2/9K6 is configured to disable the transmit scrambler during receive, since many synthesized radios will not receive with a transmit signal applied to the varicap. If you require the transmit scrambler to run all the time, place jumper JP8 on the center post and the post marked A.

The modem is directly (plug and go) compatible with the Kantronics DVR 2-2 for 9600 baud operation on 2-meters or with the Kantronics D4-10 for 9600 or 19,200 baud operation on 70-cm. If a different radio is used, modification to the radio may be necessary to provide proper deviation.

When configured for 19,200 baud operation the input/output signals are TTL. When operated through the TTL port of the D4-10, a TTL low is converted by the D4-10 into a minus 10 KHz deviation while a TTL high is converted to a plus 10 KHz deviation.

Jumpers are incorporated on the board for selecting input and output levels [analog or TTL], watchdog timer, baud rate [9600, 19200] and other modem parameters. The location and purpose of the 14 jumpers are described in the Jumpers section of this manual.

Since the modem provides its own clock, the MODEM command of the Data Engine will not display or set the baud rate. In addition, the modem develops its own carrier detect, so the MODEM command will have no effect on this function. The MODEM command can be used, however, to set the DE19K2/9K6 for half or full duplex operation.

9600 baud operation

Radios used with this modem at this baud rate require the following characteristics:

Receive
  NBFM design
  Output from discriminator
  DC coupling to output (DC response)
  Response no worse than –4dB @ 4.8 KHz
  No worse than –10dB @ 7.2 KHz
  As smooth/flat a phase delay as possible
  As smooth an amplitude response as possible
  Little change in response with 2 KHz de-tuning off channel
  Symmetric, linear FM discriminator characteristic.
Transmit
  Must generate true FM - as linear as possible
  Deviation response DC to 7.2 KHz flat
  Deviation at 4800 Hz must be ±3 KHz peak (maximum).

The Kantronics DVR 2-2 and D4-10 radios have been designed specifically for high-speed packet operation, and as such incorporate these features.

19,200 baud operation

Radios used with this modem at this baud rate require, at a minimum, these characteristics:

Receiver
- Wide band IF, 60 KHz minimum
- A smooth/linear phase response (linear-phase filter with gaussian response at 60 KHz)
- Threshold detector with TTL output (RXD)

Transmitter
- Deviation of –10 KHz for TTL low, +10 KHz for TTL high

The TTL port of the D4-10 is pin-for-pin compatible with the analog port (used at 9600), but TTL signals are used for transmit and receive data lines, TXD and RXD. In the 19,200 mode, the DE19K2/9K6 provides these TTL transmit and receive lines, and the D4-10 generates 10 KHz deviation, as mentioned above.

For 19,200 operation of the DE19K2/9K6 with another radio, a deviation of 10 KHz is recommended and a channel bandwidth of 100 KHz is required. The ARRL band plan proposes 100 KHz channels at

430.05, 430.15, 430.25, 430.35, 430.45, 430.55, 430.65, 430.85 and 430.95.

Please refer to the Kantronics D4-10 manual for more information.

Installation of the DE19K2/9K6 Modem

To install your DE19K2/9K6 modem in the Data Engine, you will need to disassemble the Data Engine. Refer to the Data Engine manual for details.

After the Data Engine PC board is removed from the case, place the circuit board on a static-free surface with the LEDs facing you. Near the back of the unit, there are two 20 pin disconnect headers just in front of each DB-15 connector. The two headers on the right are for radio port 1 and the two on the left are for radio port 2. Also, near the front of the unit, you will notice a 20 pin header labeled B_BUS2 or A_BUS1.

Carefully align the plugs on the bottom of the DE19K2/9K6 board with the pins on the appropriate disconnect headers. You must also align the BUS connector carefully with the connector at the front of the DE19K2/9K6 modem. Seat the modem firmly on the headers.

Insert the two screws through the DE19K2/9K6 board into the standoffs on the Data Engine PC board to secure the modem in place.

Carefully reassemble the Data Engine as described in the Data Engine manual.
NOTE: The DE19K2/9K6 modem may be installed in either port of the Data Engine. In order to allow installation in either port, you must have the rib of the Data Engine case positioned to the left side as you face the Data Engine front panel. If required, simply switch the front and back panels on the Data Engine case.

Connecting to Your Radio

When installed in a Data Engine (DE), the DE19K2/9K6 configures the DE rear panel DB-15 connector according to the following chart.

DB-15 pin	Function
1	PTT – Applies a ground when transmitting
2	Receive data – Data from your radio
3	Transmit data – Data from the modem to the radio
9	Ground – Receive audio return lead
10	Ground – Transmit data return lead
11	Ground – Common ground to radio
14	RTS – Low when transmitting
15	CTS – Low prevents transmitting

NOTE: All grounds on the Data Engine are common; not all are required to be connected.

As shipped from the factory, the DE19K2/9K6 modem is configured for 9600 baud operation. The selected transmit waveform (shaped audio pulses) works well with the Kantronics DVR 2-2 or D4-10 radios. With other radios, you will have to experiment with various jumper taps, JP1 through JP4, to determine the best waveform (see Jumper section).

For 19,200 baud operation four jumpers must be changed, JP9, JP12, JP13 and JP14. Again, refer to the Jumpers section of this manual. When operating at 19,200 baud, the modem utilizes TTL levels for input and output signals. These levels will work well with the Kantronics D4-10 wideband UHF radio, made especially for high speed data in the 100 KHz channels centered around 430.55 MHz.

Connection to the DVR 2-2 for 9600 baud operation:

Connection to the Kantronics DVR 2-2 using the DE19K2/9K6 modem is:

Pin 1 from the Data Engine to pin 3 of the DVR.

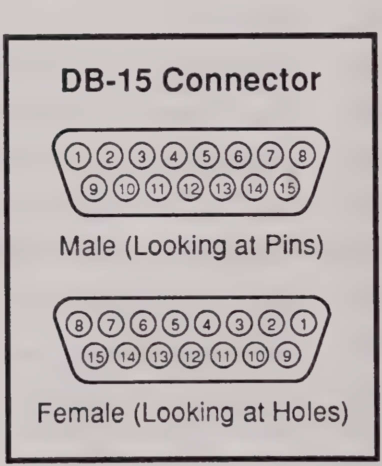
Pin 2 from the Data Engine to pin 5 of the DVR.

Pin 3 from the Data Engine to pin 1 of the DVR.

Pin 11 from the Data Engine to pin 6 of the DVR.

The input to the DVR radio requires approximately 50 millivolts p-p for 3 KHz deviation. The output from the DE19K2/9K6 modem can be set much higher, in order to provide sufficient drive for other radios. When jumper JP11 is on one post only (factory position) potentiometer R18 may be adjusted for above or below 50 millivolts. R18 must be adjusted while connected to the radio in order to provide the proper drive.

DB-15 Connector



Male (Looking at Pins)

Female (Looking at Holes)

Connection to the D4-10 for 19,200 baud operation:

When the DE19K2/9K6 is attached to the TTL port of the D4-10 for 19,200 operation, the same pin assignments are made at both ends – as in the example above for 9600 baud operation. In this way, the same cable can be used. When other radios are used some provisions will have to be made externally to convert the TTL output of the modem for proper use, depending upon the interfacing needs of the transceiver.

Jumpers on the DE19K2/9K6 Modem

There are several jumpers on the DE19K2/9K6 modem board, used to configure the modem, and to allow user experimentation. The purposes of the jumpers are:

JP1 - JP4	Transmit waveform select
JP5	Data transfer/BERT mode select
JP6	Audio loopback
JP7	Transmit DAC connect (wire jumper)
JP8	Enables/disables transmit scrambler during receive
JP9	Selects crystal (9600 – center post and A, 19,200 – center post and B)
JP10	Watchdog timer disable
JP11	Audio output level divider
JP12	Selects input filter (9600 – center post and A, 19,200 – center post and B)
JP13	Carrier detect, off 9600; on 19,200
JP14	Output (analog/TTL) (9600 – center post and A, 19,200 – center post and B)

For normal use the jumpers on the DE19K2/9K6 modem are set in the positions indicated:

JP1 - JP4	Center post and A
JP5	Center post and A (Data Mode)
JP6	One post only (loopback disabled)
JP7	Installed
JP8	Center post and post marked B
JP9	Center post and A (9600 baud)
JP10	One post only (watchdog timer active)
JP11	One post only (low level drive for DVR 2-2)
JP12	Center post and A (9600)
JP13	One post only (9600)
JP14	Center post and A (analog output)

NOTE: Jumpers JP1 through JP4 and JP8 should only be placed on the center post and A (ON), or on one post only (effectively OFF).

NOTE: Unit is jumpered at the factory for 9600 baud.

Adjustments

For 9600 Baud Operation

The DE19K2/9K6 modem provides a potentiometer (R18) for adjusting the proper drive level to your radio. If you are using the Kantronics DVR 2-2 or D4-10 radio, jumper JP11 should be placed on one post only, placing a 47K ohm resistor in series with the output from the modem to the radio. Next, key the radio and adjust R18 to provide ±3 KHz deviation (factory setting).

With other radios requiring higher drive signals, place jumper JP11 on both posts, which removes the 47K resistor. Then key the radio and adjust R18 for 3 KHz deviation.

When using the Kantronics DVR 2-2 or the analog port of the D4-10, jumpers JP1 through JP4 should be placed on the center post and A, and JP8 should be on one post only.

Other radios may require different jumper placements, and the chart below lists many of the popular combinations.

JP4	JP3	JP2	JP1	Radio
ON	ON	ON	ON	Kantronics DVR 2-2 and Audio loopback
ON	ON	ON	ON	Kantronics D4-10
ON	ON	ON	OFF	Kenwood TR2300
ON	ON	OFF	ON	Kenwood TR8300
ON	ON	OFF	OFF	Kenwood TS700
ON	OFF	ON	ON	Icom IC451E
ON	OFF	ON	OFF	Pye EUROPA
ON	OFF	OFF	ON	Pye F460
ON	OFF	OFF	OFF	Pye R461
OFF	ON	ON	ON	Mobira 325
OFF	ON	ON	OFF	Tait TAIT500
OFF	ON	OFF	ON	Salora 4624204
OFF	ON	OFF	OFF	Storno CQM700
OFF	OFF	ON	ON	Storno CQM663
OFF	OFF	ON	OFF	Home brew (G4FPV)
OFF	OFF	OFF	ON	Home brew (G8ADH)
OFF	OFF	OFF	OFF	CIRKIT 23cm kit (G3RUH)

NOTE: ON means center post and A, OFF means one post only.

The above listings were provided to Kantronics and reprinted with permission of James Miller (G3RUH).

For 19,200 Baud Operation

Other than setting the proper jumpers, there are no analog (potentiometer) settings required for 19,200 baud operation. When using the Kantronics D4-10, no transceiver adjustments should be required. The D4-10 is set for 10 KHz deviation at the factory for the TTL port.

EYE Diagrams

The "eye" diagram is a simple yet effective way of deciding whether or not the received audio is of satisfactory quality. To observe a good eye pattern perform the following steps.

Disconnect the radio from the Data Engine.

Be sure that jumpers JP1-JP4 are on the center post and A post, and JP8 is on one post only.

Be sure jumper JP5 is on the center post and A (Data Mode).

Place jumper JP6 on both posts (Audio Loopback).

Connect the trigger of an oscilloscope to pin 7 of U19 and set the timebase for 1 ms/div.

Connect the input of the scope to pin 5 of U2.

At this slow scan trace speed, the waveform looks like digital data, but with sloping edges and a slight amount of overshoot.

Change the timebase to 20 microseconds/div. At this speed the data bits become superimposed, and form the characteristic "eye".

Notice that the traces converge at two distinct points, one high (corresponding to a 1 bit), and one low (corresponding to a 0 bit). This is the point that the modem samples the audio to detect a 1 or 0.

The better the convergence at these points, the better the modem performance will be.

To view a signal received from another station, return jumper JP6 to one post only (disabling audio loopback), place jumper JP8 on the center post and B post, and connect your radio.

Trigger the scope from pin 8 of U6 (receive clock). Leave the other scope lead (input) connected to pin 5 of U2. You can now observe the received "eye" pattern from the other station. The transmitting station should adjust his jumpers JP1 through JP4 such that your received eye pattern has the best convergence.

Bit Error Rate Test (BERT)

The DE19K2/9K6 modem incorporates a BERT mode, allowing Bit Error Rate testing. To use this feature, first power up your Data Engine and then place jumper JP5 on the center post and B to generate all 0s, or on just one post to generate all 1s.

The receiving station will now show a constant 0 or 1 on the received data line (pin 5 of U2). If an error is received, the received data will output exactly 3 pulses on the received data pin.

If you count N pulses in T seconds, the channel's Bit Error Rate is (N/3)/(T*9600). For example, a count of 30 in 10 seconds would be a BER of approximately 1 in 10000 or 1x10E-4.

DE19K2/9K6 Parts List

Part Desig	Layout Locat	Schem Locat	Part Description
C1	H1	B2	4.7uf Al
C2	G1	B1	.001uf
C3	G1	D6	.1uf
C4	H2	A6	.1uf
C5	H2	A6	.1uf
C6	G2	A6	.1uf
C7	G2	C2	.1uf
C8	G2	A5	.1uf
C9	G3	C3	.1uf
C10	F1	B2	10uf Al 35V
C11	F1	A4	.1uf
C12	F1	B2	.001uf
C13	F1	B2	470pf
C14	F1	B3	.0033uf
C15	E1	B3	10uf Al 35V
C16	G1	C5	220pf
C17	F1	D5	.001uf
C18	F1	A6	.1uf
C19	F1	B2	100pf
C20	F1	A6	.1uf
C21	F3	C4	.001uf
C22	F3	C4	.0047uf
C23	F3	C4	.1uf
C24	F2	A6	.1uf
C25	E2	A6	.1uf
C26	E1	A6	.1uf
C27	E2	C3	100pf
C28	E2	D2	.001uf
C29	D1	B6	20pf
C30	D1	B6	20pf
C31	E2	A6	.1uf
C32	D1	A5	.1uf
C33	D1	A5	.1uf
C34	C1	A6	.1uf
C35	C2	A6	.1uf
C36	C1	A6	.1uf
C37	C2	A6	.1uf
C38	B1	A6	.1uf
C39	A1	A6	.1uf
C40	A2	A5	.1uf
D1	H1	B2	1N914
D2	G1	B1	1N4001
D3	G2	A5	1N5234
JP1	D3	A4	3P SIH
JP2	D3	A4	3P SIH
JP3	D2	A4	3P SIH
JP4	D2	A4	3P SIH
JP5	E3	B5	3P SIH
JP6	G1	B2	2P SIH
JP7	E1	A3	2P SIH
JP8	D2	A4	3P SIH
JP9	D1	B6	3P SIH
JP10	H1	B2	2P SIH
JP11	G1	B1	2P SIH
JP12	F2	D4	3P SIH
JP13	G3	C3	2P SIH
JP14	G1	B1	3P SIH
Q1	G1	B3	PN2222
Q2	H2	A2	2N7000
Q3	G3	B2	2N7000
R1	G1	B2	10K
R3	H3	B2	1M
R4	H3	B2	10K
R5	G2	C2	47K
R6	G3	B1	10K
R7	G3	C2	33K
R8	G3	C3	100K
R9	G3	B2	10K
R10	G3	B2	100K
R11	G1	B1	47K
R12	G1	D5	39K
R13	G1	D5	82K
R14	G1	C6	100K
R15	G1	B3	4.7K
R16	G1	A5	10K
R17	G2	C2	10K
R18	F1	B2	10K
R19	F1	B2	3.3K
R20	F1	B2	12K
R21	F2	C5	27K
R22	F3	C4	100K
R23	F3	C3	4.7K
R24	F3	D4	4.7K
R25	E3	D4	100K
R26	E1	B3	10K
R27	E1	B3	100K
R28	F1	B3	56K
R29	E2	C3	18K
R30	D1	C6	2.2K
R31	D1	B6	1M
R32	F3	C3	100K
RSIP1	D2		10K x9 SIP
RSIP1D		B4	10K x9 SIP
RSIP1B		B4	10K x9 SIP
RSIP1C		B4	10K x9 SIP
RSIP1E		B4	10K x9 SIP
RSIP1G		D3	10K x9 SIP
RSIP1A		B5	10K x9 SIP
RSIP1F		B4	10K x9 SIP

Part Desig	Layout Locat	Schem Locat	Part Description
U1	F1		TL084CN
U1A		B2	TL084CN
U1B		B2	TL084CN
U1E		C5	TL084CN
U1D		D5	TL084CN
U1C		A5	TL084CN
U2	F2		LM339
U2A		C4	LM339
U2C		B2	LM339
U2E		C4	LM339
U2D		C2	LM339
U2B		C4	LM339
U3	F1	D4	74HC164N
U4	F1	D3	74HC164N
U5	F2		74HC74N
U5B		B6	74HC74N
U5A		B3	74HC74N
U6	E1		74HC14AN
U6B		C4	74HC14AN
U6D		C3	74HC14AN
U6E		D4	74HC14AN
U6F		D4	74HC14AN
U6C		C3	74HC14AN
U6A		D2	74HC14AN

Part Desig	Layout Locat	Schem Locat	Part Description
U7	E2		74HC86N
U7D		B5	74HC86N
U7C		A5	74HC86N
U7A		D3	74HC86N
U7B		C3	74HC86N
U8	E1		74HC74N
U8B		C3	74HC74N
U8A		C4	74HC74N
U9	D1		74HC86N
U9D		C4	74HC86N
U9A		C6	74HC86N
U9C		D3	74HC86N
U9B		B5	74HC86N
U10	D2	B3	74HC164N
U11	D1	C4	74HC164N
U12	C2	A4	27C256
U13	C1	B5	74HC164N
U14	C2	A3	ZN429E-8
U15	B1	C5	4029
U16	B2	B4	ZN429E-8
U17	B2	B5	27C256
U18	A1	C5	4029
U19	A2	C6	74HC590
VR1	H2	A6	LM78L05
X1	D1	B6	2.4576MHz
X2	D1	B6	4.9152MHz

DE19K2/9K6 Parts Layout